North Carolina Department of Transportation
Division of Highways
Traffic Engineering Safety Programs

GUIDELINES
for
Benefit Cost on High Hazard Elimination (W-project) and Spot Safety Projects

These guidelines are intended to provide a tool for documentation and consistency on calculating a benefit cost ratio for all proposed Spot Safety and W-projects. A benefit cost spreadsheet has been developed to help derive the benefit cost ratio for any proposed treatment. (attachment 1)

1. Location:

- The location should include the county name and a description of the project location.
- Additional lines are provided for the name (or initials) of the engineer inputting the data, the date, and the respective file number.

2. Detailed Cost:

- Give a description of the type of improvement(s) proposed under the project.
- The columns established for items, total cost, and service life should be itemized according to the number of individual improvements.
- Attached is a list of proposed countermeasures along with their respective service lives. (attachment 2)
- Cost estimates for all projects should come from the Division for Spot Safety projects or the Project Services Unit for W-projects.

Example:
If a project proposes the construction of a turn lane and the installation of a traffic signal, there should be two separate lines provided on the B/C worksheet. The first line should be for "Construction" of the turn lane and the second line for "Traffic Signal" with the respective costs and service lives listed for each.

- PE cost **should not** be reflected in the B/C calculation for Spot Safety Projects **or** High Hazard Elimination projects.
- Companion funding(s) **should not** be reflected in the B/C calculation for Spot Safety projects.
- W-project cost estimates provided by the Project Services Unit do not include PE cost. Therefore, be sure to indicate the additional amount (10 percent) of money needed to cover any PE cost on the revised B/C calculation sheet. The additional amount added should be listed **separately** at the bottom of the B/C calculation sheet. Do not include this amount in the "Total Cost" of the project.

- When calculating the B/C for W-projects, the total cost of the project, **excluding PE**, should be used.
- Utility costs incurred due to a proposed treatment should be combined with the construction cost of that respective treatment.

Example:
A water line will need to be relocated due to the proposed construction of a turn lane. The utility cost associated with the relocation of this water line should be added to the total construction cost of the turn lane and given the respective service life for the proposed turn lane.

- All right of way costs should be listed separately and assigned a 50-year service life.

3. Estimated Annual Maintenance and Utility Costs:

- Attached is a list of countermeasures and their associated annual maintenance and/or utility costs. (attachment 3)
- Included on the attachment is an example calculation for determining the associated annual maintenance cost for the installation of guardrail.
- The annual maintenance and utility costs listed on the attachment should no longer be doubled.

4. Comprehensive Cost Reduction:

- A crash analysis is conducted for the each of the project locations and engineering judgement is utilized to determine the appropriate countermeasures. Once the appropriate countermeasures are determined, the respective crash reduction factors should be applied to all crashes of each of the correctable crash types occurring within the project location.
- Account for all crashes in the project area of the correctable crash type(s) when applying crash reduction factors. Do not isolate crashes along an approach.

Example:
After reviewing the crash data for an intersection, you determined that a right turn lane is warranted along only ONE of the four approaches. When determining the benefit cost, the crash reduction factor should be applied to ALL rear end type crashes identified within the four approaches to the intersection.

- A list of countermeasures, correctable crash types, and their respective crash reduction percentages is attached. This list may also be found at:

  http://www.doh.dot.state.nc.us/preconstruct/traffic/safety/ses/project_guide/regionalfactors.pdf

- The column established for “Pattern” on the B/C spreadsheet should list each of the individual crash types considered correctable by the proposed

countermeasure(s) as shown on the attached W-Project Crash Reduction Information document. (attachment 4)

- The column established for "%" on the B/C spreadsheet refers to the percent reduction that coincides with the chosen countermeasure(s) and the crash pattern(s) reduced/affected.
- In the case of a proposed treatment involving more than one countermeasure addressing the same crash type, the crash reduction factors from each countermeasure for the particular crash type will need to be combined using the appropriate equation included in the Recommended Procedure for Combining Crash Reduction Factors. (attachment 5)
- In the case of one proposed countermeasure having more than one percent reduction factor, it will be necessary to combine the percentages in order to calculate one overall percent reduction factor for that proposed countermeasure. To illustrate, please see the example listed below:

Example:

- Guardrail: 55% Fatal ROR Crashes, 20% Injury ROR Crashes, -50% PDO ROR Crashes

Combine Crash Reduction Factors:

- Combine guardrail CRF's broken down by severity to get a CRF for guardrail that can be applied to total crashes. The total guardrail CRF should be weighted by the percentage of target crashes present in each severity category.

$$CRF_{TotalSev} = \left(\frac{\#\text{ Fatal Target Crashes}}{\#\text{ Total Target Crashes}}\right)\left(CRF_{Fatal}\right) + \left(\frac{\#\text{ Injury Target Crashes}}{\#\text{ Total Target Crashes}}\right)\left(CRF_{Injury}\right) + \left(\frac{\#\text{ PDO Target Crashes}}{\#\text{ Total Target Crashes}}\right)\left(CRF_{PDO}\right)$$

- The column established for years on the B/C spreadsheet indicates the number of years of collective crash data. Five (5) years worth of crash data is recommended to be used for all Spot Safety and W-projects.
- The remaining columns represent the severity of the crashes identified, as well as, the number of crashes that occurred of each severity. In the "K&A" column, please indicate the number of fatal and "A" type injury crashes that occurred of each crash pattern. In the "B&C" column, please list the number of "B" and "C" type crashes that occurred of each crash pattern. In the "PDO" column, please list the number of Property Damage Only type crashes that occurred of each crash pattern.
- In a case where a proposed countermeasure has been chosen for a particular project and the only crash data available is for total number of crashes, then you should use the approach percentages (if available).

Example:

- If the proposed treatment is a left turn at an intersection and the only data available to you is for the total crashes, then you should use the following:

	1 Approach	Both Approaches
3-leg Rural Stop Sign controlled	44	
3-leg Urban Stop Sign controlled	33	
4-leg Rural Stop Sign controlled	28	48
4-leg Urban Stop Sign controlled	27	47
4-leg Urban Signal controlled	10	19

5. Injuries Per Year Reduced April 2005:

- The total annual benefits are calculated utilizing the following information:
  K & A Injuries Per Year Reduced = $ 1,300,000
  B & C Injuries Per Year Reduced = $ 40,000
  PDO's Per Year Reduced = $ 4,300

6. Benefit-Cost Ratio:

- The calculated Benefit-Cost Ratio is listed within this section. This number will be added to the Spot Safety Database and will be used in calculating the Spot Safety Index for each project.